REMARKS

In view of the above amendments and following remarks, reconsideration and further examination are requested.

The specification and abstract have been reviewed and revised to make editorial changes thereto and generally improve the form thereof, and a substitute specification and abstract are provided. No new matter has been added by the substitute specification and abstract.

Claims 7-13 have been canceled and claims 14-29 have been added.

The instant invention pertains to a pipe separator for separating oil, gas and water in connection with extraction and production of oil and gas from formations under a sea bed. Such a pipe separator is generally known in the art, but suffers from drawbacks as expressed on pages 1-2 of the original specification.

Applicants have addressed and resolved these drawbacks by providing a unique pipe separator. Specifically, with reference to Figs. 1 and 2, for example, the inventive pipe separator comprises: an extended, tubular separator body 1 having a diameter at inlet and outlet ends that is mainly equal to or slightly greater than a diameter of a transport pipe 11 to which the separator body is connected; a separator device 3 upstream of the separator body for separation of gas; and an electrostatic coalescer 4 incorporated in and constituting an integrated part of the separator body. The electrostatic coalescer 4 includes an upper electrode 12 and a lower electrode 13 in a wall of the separator body such that the upper and lower electrodes are to be supplied with an electric voltage so as to establish a vertical electric field within the separator body.

New claim 14 is believed to be representative of Applicants' inventive pipe separator.

Claims 1-2 were rejected under 35 U.S.C. § 102(b) as being anticipated by WO '297, claim 3 was rejected under 35 U.S.C. § 103(a) as being unpatentable over WO '297, and claims 4 and 5 were rejected under 35 U.S.C. § 103(a) as being unpatentable over WO '297 in view of Berry et al. In response to the positions take by the Examiner, claims 7-13 have been canceled and claims 14-29 have been added. New claim 14 recites

> A pipe separator for separation of oil, gas and water in connection with extraction and production of oil and gas from formations under a sea bed, comprising:
>
> an extended, tubular separator body having a diameter at inlet and outlet ends that is mainly equal to or slightly greater than a diameter of a transport pipe to which said separator body is connected;
>
> a separator device upstream of said separator body for separation of gas; and
>
> an electrostatic coalescer incorporated in and constituting an integrated part of said separator body, said electrostatic coalescer including an upper electrode and a lower electrode in a wall of said separator body such that said upper and lower electrodes are to be supplied with an electric voltage so as to establish a vertical electric field within said separator body.

Thus, the pipe separator as claimed includes an electrostatic coalescer incorporated into the separator body to improve and enhance separation of a fluid. Specifically, the coalescer includes upper and lower electrodes in a wall of the separator body.

With the present invention, contrary to WO '297, fluid is not fed as a dispersed flow but rather is fed as a flow that is partly separated by the pipe separator so as to have a distinct water phase at the bottom and a gas phase at the top. Although the invention includes insulated external electrodes to make an electrical field, these electrodes merely act as a capacitor due to a vertical field created by the upper and lower electrodes. The real electrodes acting across the oil layer is the stratified water phase and the top insulated electrode (for oil/water flows), or the stratified water and gas phases (for three phase stratified flow). With the present invention, separation actually takes place across the electrostatic coalescer. The coalescer is therefore an integral part of the separator body having the same internal diameter and axial flow velocities as a transport pipe the pipe separator.

With specific reference to the claims, claim 14 recites that the electrostatic coalescer includes

> an ***upper*** **electrode and a** ***lower*** **electrode** in a wall of said separator body such that said upper and lower electrodes are to be supplied with an electric voltage so as to establish a vertical electric field within said separator body

In other words, the claimed electrodes have different vertical positions relative to one another.

To the contrary, WO '297 describes an electrostatic coalescer in which the electrodes 5 and 6 are helically wound around a pipe such that they have the same vertical positions, whereby the electric field established in WO '297 has a direction different than that recited in claim 14. Thus, claim 14 is not anticipated by WO '297.

Berry does not resolve this deficiency of WO '297, whereby claims 14-29 are allowable over these references either taken alone or in combination.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

Per GRAMME et al.

By: Joseph M. Gorski

Joseph M. Gorski
Registration No. 46,500
Attorney for Applicants

JMG/nka
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
December 10, 2007

Version with Markings to Show Changes Made

A Pipe Separator ~~with Improved Separation~~

The present invention concerns a pipe separator for separation of fluids, for example separation of oil, gas and water in connection with ~~the~~ extraction and production of oil and gas from formations under ~~the~~ a sea bed, comprising an extended, tubular separator body that has a diameter at ~~the~~ inlet and outlet ends that is mainly equivalent to ~~the~~ a diameter of ~~the~~ a transport pipe to which the pipe separator is connected, a cyclone arranged upstream of the separator body for separation of any gas present, and an electrostatic coalescer arranged in connection with the pipe separator.

~~The applicant's~~ Applicant's own Norwegian ~~patent~~ Patent ~~application~~ Application ~~nos~~Nos. 19994244, 20015048, 20016216, 20020619 and 20023919 describe prior art pipe separators for ~~the~~ separation of oil, water and/or gas downhole, on ~~the~~ a sea bed or on ~~the~~ a surface, on a platform or similar. In particular, ~~patent~~ Patent ~~application~~ Application ~~no~~No. 20023919 shows a solution in which a separate, compact electrostatic coalescer is used in connection with ~~the~~ a pipe separator. ~~The~~ oOil flow from the pipe separator is passed to the coalescer downstream of the pipe separator and subsequently to a further oil/water separator that removes ~~the~~ remaining water after separation in the pipe separator. This prior art solution is particularly designed for, but not limited to, medium heavy oils with water removal from ~~the~~ an oil phase to 0.5% water, and using a cyclone or other type of gas/liquid separator to remove gas before the pipe separator.

~~The~~ This solution requires an additional separator, which is complicated and expensive, and the coalescer itself, which is of a vertical type, cannot be reamed or pigged

(cleaned) in ~~the~~ a conventional manner. This also represents a considerable disadvantage of the prior art solution.

The present invention represents a considerably simplified separation solution in which the above disadvantages are avoided. The present invention is ~~characterised~~ characterized in that ~~the~~ an electrostatic coalescer is incorporated in and constitutes an integrated part of ~~the~~ a separator body~~, as stated in the attached claim 1~~.

~~The dependent claims 2-5 indicate the advantageous features of the present invention.~~

The present invention will be described in further detail in the following with reference to ~~the~~ attached drawings, where:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an elementary sketch of a pipe separator in accordance with the present invention.

Fig. 2 shows an enlarged part of the separator shown in Fig. 1 in ~~the~~ an area of ~~the~~ a coalescer in a cross-section a) and a longitudinal section b).

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

~~The~~ A solution shown in Fig. 1 is a separator that comprises a tubular separator body 1, a liquid seal 6, arranged downstream of the separator body, for ~~the~~ a water phase in ~~the~~ fluid (oil/water) that flows through the separator, a drainage device 7 with an outlet 8 for ~~the~~ separated water, a pig battery 5, arranged upstream of the separator body in connection with a well head 9, a connection pipe 10 that connects the well head to the separator body 1, and a transport pipe 11 for oil downstream of the separator body. ~~The~~ A special feature of the present invention is that a coalescer 4 is incorporated in the separator body 1 as an integrated unit. The coalescer is expediently arranged at a distance of between 1/3 and 1/2 of ~~the~~ a length of the separator body from ~~the~~ an inlet of the separator body. However, its location is not limited to this.

Fig. 2 shows in large scale, in cross-section and longitudinal section, ~~the~~ a part of the separator body in which the coalescer is incorporated. As ~~the~~ this figure shows, the coalescer

comprises an upper electrode 12 and a lower electrode 13 that are enclosed in expediently insulating material in ~~the~~ a wall 14 of the separator body. The electrodes are designed to have applied thereto ~~them~~ (not shown in further detail) an expedient voltage "V" (AC voltage) to create an electric field that contributes to increasing ~~the~~ separation of water from ~~the~~ fluid (oil and water) flowing through the separator. As Fig. 1 shows, a cyclone 3 (or another expedient gas/liquid separator) is arranged upstream of the separator body 1 to remove any gas from ~~the~~ fluid that is produced in the ~~wells~~ well head 9. ~~The~~ An intention of removing ~~the~~ gas is to ~~avoid~~ prevent ~~it~~ the gas from reducing ~~the~~ an effect of the coalescer, as the gas is a poor electrical conductor. Another intention is to prevent ~~the~~ formation of plug flow in the separator.

~~The~~ A method of operation of ~~the~~ a separator solution in accordance with the present invention is otherwise as follows:

Fluid, i.e. gas, oil and water, that is produced is passed first to the cyclone 3, where ~~the~~ a majority of gas is removed and passed on in a separate pipe 9, possibly being reintroduced into the transport pipe 11 after the separator body 1.

~~The~~ A liquid phase, which may contain small amounts of gas, is introduced into the separator body 1. Free water will separate quickly and form a water phase under ~~the~~ an oil phase. ~~The g~~Gas bubbles will collect in ~~the~~ a top of the separator pipe and, depending on their concentration, form a free gas phase. When coarse separation has been completed (i.e. the water phase on ~~the~~ a bottom, the oil phase with small oil drops in ~~the~~ a ~~centre~~ center, and possibly a thin gas phase on ~~the~~ a top), the fluid will pass into ~~the~~ integrated coalescer 4.

In the coalescer 4, a voltage drop will be created mainly over ~~the~~ an oil zone because ~~the~~ a water zone conducts current and ~~the~~ a gas zone also has good conduction properties. The voltage drop over the oil zone (alternating current) produces an increased drop in coalescence and ~~destabilises~~ destabilizes ~~the~~ an oil/water interface. ~~The w~~Water drops grow in size and will separate quickly after the fluid has entered the ~~pipe~~ separator ~~element~~ body 1 again.

In the separator ~~element~~ body downstream of the coalescer, ~~the~~ coalesced water drops will be separated out and collected in the collection unit 7, where ~~the~~ water is drained out via the pipe 8. ~~The~~ oOil will flow on past the water seal 6 to the transport pipe 11.

The present invention as it is defined in the claims is not limited to the example shown and described above. The separator may be provided with two or more coalescers 4 arranged in series in the separator ~~element~~ body 1. This may be particularly relevant for oils that are difficult to separate such as heavier oils.

The cyclone 3 may also be located in places other than the well head as shown in Fig. 1. It has proved expedient for the cyclone to be located in connection with equipment that causes high shear for ~~the~~ fluid, as this produces good separation conditions. However, it may also be relevant to locate the cyclone in close proximity to the separator's inlet in situations in which the separator is located far from the well head.

Abstract of the Disclosure

A pipe separator is for separation of fluids, for example separation of oil, gas and water in connection with the extraction and production of oil and gas from formations under the a sea bed. It The pipe separator comprises an extended, tubular separator body (1) that hashaving a diameter at the inlet and outlet ends that is mainly equal to or slightly greater than the a diameter of the a transport pipe to which the separator body is connected. A cyclone (3) is arranged upstream of the separator body for separation of any gas present. An electrostatic coalescer (4) is incorporated in and constitutes an integrated part of the separator body (1).